ASSESSMENT OF ERGONOMIC ADAPTABILITY PRACTICES AMONG SELECTED CONSTRUCTION CRAFTSMEN IN ABUJA

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DECLARATION

I declare that the work in this thesis title 'Assessment of Ergonomic Adaptability Practices among selected Construction Craftsmen in Abuja' has been performed in the Department of Building. The information derived from literature has been duly acknowledged in the text and a list of reference provided. It has not been presented in any previous application for any degree. No part of this project has been presented for another degree or diploma at this or any other Institution.

_____	_____	_____
Mustapha Tasiu	Signature	Date

CERTIFICATION

This thesis titled '**ASSESSMENT OF ERGONOMIC ADAPTABILITY PRACTICES AMONG SELECTED CONSTRUCTION CRAFTSMEN IN ABUJA**' meets the regulations governing the award of the degree of Master of Science in Construction Management of Ahmadu Bello University, and is approved for its contribution to Knowledge and literary presentation.

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DEDICATION

This research is dedicated to my family for their patience and support.

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ABSTRACT

Health and safety is about the prevention of ill-health among workers caused by their working conditions. Ergonomics is one of the methods to eliminate the health hazards and risk in the construction industry. The aim of the study is to assess adaptability of ergonomic practices among selected building construction craftsmen in Abuja with a view to enhancing health and safety practices on the construction site. The study assesses awareness of ergonomics among building construction craftsmen. The study also assesses the challenges and drivers to ergonomics among construction craftsmen. One hundred and Twenty five interviews were conducted among Masons, Electricians, Carpenter, Tilers and Iron-fixers. Site observation was used to fill checklist assessing adaptability of ergonomics practices on construction site in Abuja. Data was analysed using percentage. The study found that awareness of ergonomics among craftsmen is low with at of 4%. It also found that 66% of craftsmen have experienced Work related musculoskeletal injuries. The study concludes that ergonomics practice among craftsmen is low. Lack of knowledge and understanding of ergonomics, cost of procuring ergonomic equipment, employees reluctant to use safety tools and gadgets, lack of legislation enforcing ergonomics practices and temporary employment were factors militating against adoption of ergonomics. The study recommends increasing awareness of ergonomics through education and training. Introducing ergonomics in the syllabus of construction related courses in tertiary institution, continuous professional development of professional bodies and apprenticeship training of craftsmen.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Construction workers have high injury rates and construction work by its very nature is difficult. This could be because of working above the shoulder and below the knees level, and also building materials are heavy. Mcintos (2001) in Abdulahi (2012) declare that working in the construction industry has been identified as a risk factor for chronic disability. Every year many construction site workers are killed or injured as a result of their work; others suffer ill health, such as musculoskeletal disorders (Health and Safety Executives, 2006).

According to Muhammed (2014) occupational health and safety in construction is about preventing people from being injured at work or becoming ill through appropriate precautions and providing a satisfactory working environment. Health and safety is about identifying risk and eliminating or controlling factors to prevent accident and occupational ill-health (European Commission, 2011). Health and safety is an inevitable aspect of construction because the only time an employee will perform his duties is when the employee is in good health and is sure of a safe working environment. Any rational worker or employee will perform his or her duty diligently when he knows that even in case of an injury or accident he will be taking care of. One of the efforts in trying to prevent occupational hazard in construction is ergonomics. Al-Swaity and Enshassi (2012) assert that ergonomics is one of the procedures that eliminate the hazards and risk in the construction industry.

Ergonomics produces and integrates knowledge from the human sciences to match jobs, systems, products, and environments to the physical and mental abilities and limitations

of people (Oostakhan, Vosoughi and Khandan, 2012). Ergonomics seeks to safeguard safety, health and well-being of workers whilst optimizing efficiency, productivity, comfort, health and performance.

Ergonomic is the science of designing the job to fit the worker, rather than forcing the worker to fit the job (Kroemer and Grandjean, 1999). It takes account of the capability and limitation of the human body. It applies information about human behaviour, abilities and limitations and other characteristics to the design of tools, machines, tasks, jobs and environments for productive, safe, comfortable and effective human use" (Saunders and McCormick, 1993). Ergonomics attempts to achieve this by better fitting the task to the worker rather than forcing the worker to adapt to the work. It also tries to come up with solutions to make sure workers stay safe, comfortable, and productive (Oostakhan, Vosoughi and Khandan, 2012). Ergonomic principles are derived from many areas, including: biomechanics, physiology, anthropometry, industrial engineering and safety (Alswaity and Enshassi, 2012)

An ergonomics program systematically identifies and controls the risk factors that are known contribute to cumulative trauma and overexertion on construction workers or craftsmen. The broad categories of occupational risk factors include repetitive motions, manual material handling, awkward posture (positions), forceful exertions, mechanical pressures on soft tissues, contact stress, cold temperatures, prolonged equipment operation and inadequate rest (AbdulHafeez and Tasiu, 2016). Ergonomics provides help and assistance on how to work safely on most tasks encountered on the construction site. It also identifies the main causes of accidents and ill health, and explains how to eliminate hazards and control risks.

Essays (2013) opined that there are two major goals behind the establishment of ergonomics; to ensure that health of the workers is observed and to ensure optimized

production from the employees. Ergonomics has a responsibility to put people in the forefront; give the workers the first priority, while taking into account their capabilities as well as limitations (Jaffar et al., 2011). The central aim of ergonomics is to ensure that tasks, information, environment and equipments are suitable for every worker. It can be seen that ergonomics implementation in construction would not only enhance health and safety but could also enhance productivity.

1.2 Statement of Research Problem

Despite the existence of machinery and instruments, use of the human in building and construction work is inevitable; therefore the methods of using the body for executing tasks are still of great importance. Poor working methods in building construction cause losses in terms of physical and mental injuries and economics losses because working in the building and construction industry is hazardous and risky (Smallwood, 2012).

According to Jabarani (2013) the construction industry has high rates of injuries and illnesses. Complexity of the projects and extensive scope of the works in construction industry make the workers to be exposed to injuries, illnesses, disabilities or even death. Ahankoob and Charehzehi (2013) assert that musculoskeletal disorder is the most common ergonomic injury problem in the construction industry. Ohio Bureau of Workers Compensation (OBWC) (n.d) adds that many of the injuries in the construction sector are musculoskeletal disorders caused by cumulative trauma which can be associated with such activities as manual material handling, hand tool usage, awkward postures and prolonged equipment operation. This type of injury can really affect the health of the people that are exposed to the hazards for a long period of time. Musculoskeletal injuries can cause temporary or even permanent disability, which can affect the workers earning and contractor's profit (Albers and Estill, 2007).

Buckley (2009) agrees that strains, sprains and other physical ailments have long been a drain on construction productivity and a risk to overall worker health and safety.

The frequency of back injuries for construction work is more than twice that of other industries (Muiruri and Mulinge, 2014). That means a substantial number of work-site injuries are a result of wear and tear on the body where the capabilities/limitations of the human body are exceeded or overexerted

Examples of Musculoskeletal problems are masons with back problems due to the repeated lifting of cement block, carpenters with wrist problems due to repeated use of a hammer and iron bender with back problems due to constant and prolonged bending while fixing and tying reinforcement bars. Smagacz (2004) declare that 54% of all construction injuries/illnesses are ergonomic-related. From the above it can be seen that musculoskeletal injury is a problem in the building industry and adopting ergonomics practices can help solve this problem.

1.3 Justification for the Study

Musculoskeletal disorders constitute a major health challenge for construction workers. When caused or aggravated primarily by performance of work or by the effect of the immediate working environment, they are described as work-related musculoskeletal disorders (WMSDs). The construction industry provides an environment that increases the vulnerability of workers to sustaining work-related musculoskeletal disorders (Ekpeyong and Iyang, 2014)

The construction industry entails a wide range of activities, which expose workers to unfavourable ergonomic challenges. According to Ajayi and Thwala (2012) construction worker in Nigeria is likely to be temporarily unfit to work at some time as a result of injury or health problems after working on a construction site. There is a prevalence of unfavourable ergonomic practice in the sector thereby affecting the

productivity of the construction workers. However the study of the literature indicate that safety consideration of construction workers in construction project delivery is not given a priority and the employment of safety measures during construction is considered a burden as it is not addressed. Construction workers in Nigeria are always exposed to unfavourable ergonomic factors and severe environmental hazards which results in acute injury, chronic illness, permanent disability or even deaths through immediate effects of direct exposures. Findings by Ajayi and Thwala (2012) indicated that the manner in which construction activities are executed in Nigeria's construction industry adversely affects the health and safety of construction workers as it precipitates into Work related musculoskeletal disorders (WMDs).

Ekpeyong and Iyang (2014) the overall prevalence of work related Musculoskeletal Disorder in the Nigerian construction industry was 39.25%, and iron workers experience work related Musculoskeletal Disorder was at 55.7% and they called for ergonomics adoption in the Nigerian construction industry.

It is against this background that this research is carried to study the adoptability of ergonomics among construction craftsmen to enhance adoption of ergonomics in solving the problem of musculoskeletal injuries and illness in Nigerian building industry. This would translate in to achieving a comfortable, productive and satisfying working environment for construction craftsmen, free from musculoskeletal injuries.

1.4 Aim and Objectives

1.4.1 Aim

The aim of the study is to assess adoptability of ergonomic practices among selected building construction craftsmen in Abuja with a view to enhancing health and safety practices.

1.4.2 Objectives

The objectives are

1. To examine the awareness of ergonomics among Building Construction Craftsmen.
2. To assess the adoptability of ergonomics of practice among building construction craftsmen.
3. Identify factors militating against ergonomic adaption among construction craftsmen
4. Identify factors to enhance adoption of ergonomic among construction craftsmen

1.5 Scope and Limitations

1.51 Scope

The study assessed the adoption of ergonomics among building construction craftsmen in Abuja. The study was limited to Carpenters, Iron- Fixers, Tilers, Masons and Electricians because their ergonomics interventions were the most prevalent from literature.

1.5.2 Limitations

The respondents of the research are craftsmen, so their level of education is lower than that of professionals; this also affected the method of data analysis used for the study. Communication in English was difficult and sometimes the researcher had yo resort yo the use of the local language in conducting research. Some respondents were

interviewed while working which didn't allow an in-depth interview. Some construction company didn't give full access to their site. The response rate would have been higher.

CHAPTER TWO

LITERATURE REVIEW

2.1 Health and Safety in Construction

Occupational health is concerned with the promotion and maintenance of physical, mental and social wellbeing of workers. Occupational health and safety has been defined by the International Labour Organization (2001) as: *"The prevention and maintenance of the highest degree of physical, mental and social well-being, the prevention of ill-health among workers caused by their working conditions, The protection of workers from factors adverse to their health in their employment, and the placing and maintaining workers in occupational environments adapted to their individual and psychological conditions".*

According to Cambridge Dictionary online (2015) safety is a state in which or a place where an individual feels safe and is not in danger or at risk. It is a condition of being protected from or unlikely to cause danger, risk, or injury. Health and safety at construction sites deals with both physical and psychological well-being of workers on construction sites and other persons whose health is likely to be adversely affected by construction activities (Muiruri and Mulinge, 2014). It is of primary concern to employers, employees, governments and project participants. Health and safety therefore is an economic as well as humanitarian concern that requires proper management control.

Many construction activities are health and safety risk. They include activities such as working at height, working underground, working in confined spaces and close

proximity to falling materials, handling load manually, handling hazardous substances, noises, dusts, using plant and equipment, fire, exposure to live cables, and ergonomics (Clark, 2003).

Construction industry is considered as being risky with frequent and high accidents rate and ill-health problems to workers and practitioners. The construction industry has therefore earned the reputation of being a dangerous or highly hazardous industry because of the disproportionately high incidence of accidents and fatalities that occur on construction sites around the world (Smallwood, Haput and Shakantu, 2008).

According to Muiruri and Mulinge (2014) construction safety and health management therefore deals with actions that managers at all levels can take to create an organizational setting in which workers will be trained and motivated to perform safe and productive construction work. According to Mbuya and Lema (2004) in Muiruri and Mulinge (2014) in most developing countries, health and safety consideration in construction project delivery is not given priority, and employment of safety measures during construction is considered a burden. Health and safety has been identified as a parameter which should be used along with the traditional parameters: cost, quality and time, to measure the success of projects (Hinze, 1997).

Unfortunately, health, safety and the environment are often neglected on construction sites and rarely managed. According to Diugu *et al.*, (2013) safety and health is often discussed in site management meetings as a priority, while in reality safety and health takes a low priority to budget and time discussions. The culture of the construction industry in developing countries like Nigeria does not promote health and safety. The practices of competitive tendering and award of most public contracts to the lowest bidder in many developing countries compels contractors to drive their prices low while cutting costs which in turn affects health and safety (Khan and Khan, 2015).

A health and safety policy sets out the general approach and commitment together with the arrangements to be put in place for managing health and safety. A health and safety policy is usually made up of three parts: which includes a statement of intent, organisation details and safety arrangements (HWL, 2015). The statement of intent which is a written policy statement shows everyone the organizations commitment to health and safety, and the organisation details names those who will have responsibilities for health and safety matters in the work place or site. While arrangements explains how to control the hazards that have been identified during risk assessment.

Health and safety policy is a legislative instrument put in place to ensure that at all times the safest and healthiest working condition is provided on construction site using measure of international standard (Muhammed, 2014). Site managers should have a written safety policy for their enterprise setting out the safety and health standards which it is their objective to achieve. The policy names the senior executive who is responsible for seeing that the standards are achieved, and who has authority to allocate responsibilities to management and supervisors at all levels and to see they are carried out (Muriri and Mulinge, 2014). Construction safety policy therefore is something that must be developed by each site manager and operating company prior to starting any construction job. Once developed the development safety plan should be placed into a training program that is needed to be participated in by every site worker prior to partaking in any job found on the positioning irrespective of the roles simplicity. Site meetings are one of the ways of sensitizing workers on their health and safety in the site and should therefore be held frequently.

There are several reasons why workplaces need a health and safety policy or program, according to Health and safety Executives (2006):

1. To clearly demonstrate management's full commitment to their employee's health and safety.
2. To show employees that safety performance and business performance are compatible.
3. To clearly state the company's safety beliefs, principles, objectives, strategies and processes to build buy-in through all levels of the company;
4. To clearly outline employer and employee responsibility and accountability for workplace health and safety.
5. To comply with the Occupational Health and Safety Act.
6. To set out safe work practices and procedures to be followed to prevent workplace injuries and illnesses.

2.2 Ergonomics and Ergonomics Awareness

Ergonomics aims at avoiding injury and improve health, safety and comfort. The goal of the science of ergonomics is to find a best fit between the worker and the job condition. Too often employees perform job tasks that expose them to potential injuries and illness due to the poor design of a workstations or tool they are using. According to Michigan Occupational Safety and Health Adminstration (2013) ergonomics involves the assessment of job tasks to identify ergonomic risk factors and appropriate engineering or work practices controls to reduce or eliminate the identified risk factors. Ergonomics tries to come up with solutions to make sure workers stay safe, comfortable, and productive (Albers and Estill, 2007).

Cohen *et al*., (1997) described ergonomics as the science of fitting job demand to the capability of the working population to people. Ergonomics encompasses the body of knowledge about physical abilities and limitations as well as other human characteristics that are relevant to job design (‘Ergonomic Process’, n.d).

Ahankoob and Charehzehi (2013) also described ergonomic as adapting the physical environment with physiological, physical, and psychological capability and limitation of the human by considering different discipline such as anatomy, physiology, psychology, sociology, physics, and engineering.

According to Kaminskas, Barauskienė and Bingelienė (2013) ergonomics is a new topic for the construction industry, but the ideas have been around for many years. There is still a strong case for using ergonomic improvements both to reduce workers' exposure to risk factors for Work Musculoskeletal Disorders and to improve their productivity. There is need for construction ergonomics to prevent and also reduce the likelihood of a worker suffering from long term disabilities.

Ergonomics on the construction site according to Ahankoob and Charenzehi (2013) are to; improve quality, adopt human capability with optimal situation, balance requirement and limitation, increase productivity, make easy the human performance, provide a safe and healthy working environment, reduce disorders, decrease costs, and improve morale of the workers.

Ergonomic awareness is important in implementing ergonomics. Awareness among both management and employees is critical. Ergonomics awareness entails knowing ergonomics and its benefits, identifying parts of the body that get injured at work and identifying work activities that can lead to injury (Washinton State Department of Labour and Industries, 2012). Employees and supervisors are the most critical stakeholders in ergonomics awareness. Employees are the most affected since they do the job while supervisors ensure they are done properly and in the right way. When majority of the workers have no exposure to ergonomics training they adopted harmful postures at work which will increase the risk of musculoskeletal injuries. According to Ayeyemi *et al.*, (2013) it is the responsibility of

site supervisor to supervise the safe work procedures and workers also are trained the employees to follow such safe work techniques.

2.3 Construction Industry Ergonomic Intervention

Construction industries ergonomic interventions are practices that have been found to reduce the prevalence of musculoskeletal disorder in construction.

2.3.1 Manual materials handling

The construction environment is often labour intensive and involves the manual handling of materials. These materials can include bricks, block, lumber, bags of cement, etc. Often the items are bulky, and employees must carry them over rough terrain. Not only are slips and falls prevalent, but manual materials handling can place large forces on the spine and is associated with back and shoulder injuries (Adeyemi *et al*., 2013).

The forces on the spine and, hence, the risk of injury can be greatly reduced by mechanizing the manual material handling tasks. According to Ohio Bureau of Workers Compensation (n.d) machinery is commercially available that can aid in material handling in the construction environment. Rough terrain forklifts can move pallets of material from trucks to the area where the items are needed. Some have the capability to reach material up several stories. This type of machinery can also reduce slip and fall injuries by reducing or eliminating carrying distances, and carrying over rough or slippery terrain.

2.3.2 Mini-break

Giving construction workers time to rest during a work day is important. However, it is important to stretch, when doing tasks that demand a great deal of physical effort, or while doing a job that forces the body into awkward positions. A mini-break is when work is stopped, the worker then stretch and relax the parts of the body that are working

(Occupational and Industrial Orthopaedic Centre, 2003). This helps fresh blood to circulate through tired muscles and joints, providing the oxygen needed to continue to work. A few seconds here and there may not add up to much time, but can make a tremendous difference in how you feel at the end of the workday.

According to Alter (1988) the important thing is to practice taking mini-breaks. During periods of static muscle activity, where the muscles must hold without moving, or prolonged, heavy dynamic work. Where the muscles are working hard, it is very important to take mini-breaks; several seconds to stretch and relax. Failure to do this may result in painful muscles and joints.

2.3.3 Ergonomics tools

Using a conventional hand tool over and over can lead to muscle strain or even a serious injury like carpal tunnel syndrome or tendinitis. Using the wrong tool, or using a tool the wrong way, can strain the hand, wrist, forearm, shoulder, and neck.

According to Albers and Estill (2007) a tool can be considered "ergonomic" When it fits the task, fit the hand, allows a good grip, takes less effort, does not require work in awkward position, does not dig into your fingers or hand and is comfortable and effective. The overall safety and efficiency of many construction activities depends, to a large extent, on the quality and design of the tools being used. Tools extend the hand's capabilities and often provide a more powerful, efficient method for getting a job done. But repetitive use of a tool that's poorly designed, uncomfortable to hold, or vibrates intensively can result in cumulative injuries ('Tool Ergonomic', 1994).

Common cumulative injuries include low-back strain, tendonitis, and chronic hand or wrist pain (carpal tunnel syndrome). Discomfort, numbness, and loss of strength are some of the symptoms of these injuries and they often take weeks or months to develop.

If workers are experiencing any of these symptoms, it's important to evaluate the tools they are using.

2.3.2 Characteristics of ergonomically designed tools

The design of a tool usually determines the comfort level the user will experience. Many hand and power tools now on the market incorporate ergonomic principles into their designs to enhance comfort and help prevent cumulative injuries. The characteristics to look for in ergonomically designed tools according to (Tool ergonomics, 1994) are;

1. Reduce awkward postures. Select tools with handles designed in such a way that hand and wrist bending is minimized.

2. Well- balanced. Well- balanced tools are easier to hold and operate.

3. Require minimal grip strength.

4. Easy to operate. Power tools that are easy to turn on and off are more comfortable to use.

5. Reduce vibration.

Many tools are now available that are designed to produce less vibration. They should conform to Organization for Standardization (ISO) vibration standards (ISO 10819). Anti-vibration gloves could also be used.

2.3.4 Carpentry

The following are ergonomic practices according to The National Institute for Occupational Safety and Health (2007) for carpentry and wood work;

1. Wear well worn boots to increase the sensation of the surface beneath your feet.
2. Wear gloves to protect the hands from splinters and to help improve grip.
3. After about 20 - 30 minutes of repetitive bending and lifting take a mini-break for a few seconds. Straighten your back and stretch, take a few steps in place and

then resume working. This can promote increased blood flow to tired muscles and joints and prevent discomfort.

4. Maintain a good level of fitness and flexibility.
5. Have materials neatly arranged as close to where they will be used as possible

The following are some Ergonomic Personal Protective Equipments used in carpentry operations

1. Shock absorbing shoe inserts
2. Leg wedge
3. knee pad
4. Nail and screw gun
5. Adjustable saw horse

2.3.5 Iron- Fixing (steel work)

While tying rebar at ground level, the iron bender has to work in a stooped position, with the body bent deeply forward. It is important that during the operation the worker take micro breaks to stretch your muscles and allow them to briefly go back into a natural position. The National Institute for Occupational Safety and Health (2007) gave some ergonomics intervention for iron fixing operation they are;

1. Ask for help when lifting a heavy or awkward load from the floor and never lift or carry more than is comfortable.
2. Use the safest lifting guidelines possible.
3. Try to have materials stored on racks off the ground at waist level.
4. Wear gloves to improve grip.
5. Wear a shoulder pad or use a rolled up sweatshirt to protect the sensitive structures and skin around the shoulder, and to help distribute the load.
6. Maintain good housekeeping to prevent trips, slips and falls.

7. Wear well worn boots as they allow you to better sense the surface beneath your feet.
8. Use all appropriate PPE including hardhat and gloves to protect the hands and improve grip.
9. A load of rebar is stored on racks off the ground. This will enable the laborers to more easily lift these materials, avoiding the need for lifting from ground level.

There should be restriction on the weight of material to be carried by one person which is 50 kg according to the ILO standards. The following are some ergonomic equipment for iron fixing operations according to

2.3.6 Tilling

OSHA (2007) proposed the use of knee pads while kneeling for tilling work. A knee pad is a cushion that can be worn directly over the knee. Usually it is soft on the inside with a tough outer surface. When the worker kneels, the pad acts as a cushion between the bones of the knee and the surface you are kneeling on. The knee pad lessens the amount of stress on the knee joint from the contact with a hard surface. The kneeling creeper has two uses, one as a seat and another as a knee placement for low groundwork. Using a portable kneeling creeper with chest support when the job requires kneeling or squatting to work at floor level reduces the stress to your knees, ankles, and lower back (Albers and Estill, 2007). Kneeling creepers are available with removable seats and cushioned knee supports. They are very low and have 2 to 3 inch casters. The knee supports on one model are only 3/4 inch above the floor. The cushioned knee supports reduce the pressure on your knees, just as ordinary knee pads do.

According to Ahankoob and Charehzehi (2013) adding fixture to tools and providing tripod benches reduces the need for cutting tiles at floor level. By this approach,

workers spend less time putting their knees and palms on the hard surface of the tiles which palliates pressure on soft tissues.

2.3.7 Masonry work

Taking micro breaks to stretch your muscles and allow them to briefly go back into a natural position. The National Institute for Occupational Safety and Health (2007) gave ergonomics intervention for Mansory or concrete work operation they are;

1. Always wear protective gear to keep cement from getting on the skin or clothing – be sure to wipe away what does get on your skin.
2. Wear gloves to prevent blisters and calluses from developing on the hands.
3. When shovelling concrete the work is fast paced and demands explosive physical exertion. Although time is important, it is equally important to take a mini-break every 30 minutes, a few seconds to relax the arms and back to promote increased blood flow to tired muscles and joints.
4. Always wear protective gear to keep cement from getting on the skin or clothing – be sure to wipe away what does get on your skin.
5. Wear gloves to prevent blisters and calluses from developing on the hands.

2.3.7 Electrical work

Ergonomics practices according to OSHA (2007) are;

1. Fixture lifts, so the worker does not have to lift and hold the fixture.
2. Scissor lifts to give the worker a mobile platform on which to work;
3. Power tuggers.
4. Multi-ton rollers to move switchgear and heavy objects around without making a worker pull the entire crew over to “muscle” something up;
5. Air packs (which are like air tables) on which a heavy object can be placed and moved around with a flow of air.

6. Cordless (battery) screwdrivers. It takes 10 partial wrist twists to put on a wire nut. A worker can use an adapter on a battery; screwdriver—all the worker has to do is hit the trigger and it turns the wire nut onto the wire;
7. Cranes.
8. Pipe racks, instead of storing pipe on the floor.

2.4 Challenges to implementation of Ergonomics in Construction

Awareness has been proven to play an important role in providing the safest and healthiest work environment possible for employees, and ergonomics is still not a hot issue to be considered by many construction companies (Ahankoob and Charehzehi, 2013). The level of ergonomics application and general awareness are low in many countries (Alswaity and Enshassi, 2012). There is also no specific statistic on ergonomics risk such as MSD and Carpal Tunnel Syndrome (CTS) to show the severity of ergonomics injury in Nigeria.

According to Smagacz (2004) contractors often cite the following reasons for reluctance to implement ergonomic changes: Extra equipment costs (and theft of this equipment), and increased workers' compensation liability (increased awareness of possible injuries among workers).

Dubblestyne (2008) reports that challenges to implementing ergonomic change are; employees not involved in the change process, communication disconnects, many employers simply do not comprehend the term "ergonomics", ergonomics still considered by some as "voodoo science, time study" approach still favored and ergonomics not considered during the design phase.

Other challenges include; costs can be prohibitive, technology change can result in loss of jobs, ergonomic assessment reports often do not specify practical recommendations,

lack of resources/funding/training, maintenance and psychosocial aspects are not addressed.

1. According to Boatman, Chaplan andTeran (2012) challenges to applying ergonomics to construction are;
2. Business and financial concerns. The contractors are clearly responsible for meeting the financial obligations and making certain the business is profitable. Naturally they are concerned about practical issues that would impact their ability to do the work profitably, safely and competitively. Their top business concerns when considering ergonomics were: impact on production, cost, competing in the current economic downturn, and bidding on jobs.
3. Attitudes and perceptions- Resistance to change attitudes make implementation of ergonomic solutions more challenging to achieve.
4. Lack of knowledge and understanding-Across the board, there is a lack of awareness of the connection between the hazards and injuries, often because the injuries are cumulative and not taken seriously until a worker is unable to perform their job.
5. Lack of availability of solutions-Many tools have not been redesigned to be ergonomically-friendly and those that have are often more expensive, and therefore not accessible to apprentices. Also, some tools redesigned for safety are less effective in the field.

2.5 Drivers to adoption of Ergonomics in Construction

A regulation forcing ergonomic issue, educating construction firms on the productivity gained through ergonomic tools is key to ergonomic practice adoption (Buckley, 2009). Increasing the knowledge among the construction employee by training would increase the understanding of ergonomic problems in construction. Employees should use anti-

vibration gloves while handing vibrating tools. Using equipment that may produce less vibration would be the best solution before using personal protective equipment (Choi, 2008).

Centre for Construction Research and Training (CPWR) (2000) adds that constructability reviews conducted during the design process should address ergonomics. Design and details should be simple and should complement the use of system formwork, prefabrication; pre-assembly and mechanization do reduce the effects of various ergonomic problems.

Oostakhan, *et al*., (2012) opined that dynamic and integrated safety training and raising workers awareness of potential risks and using personal protective equipment could also be effective. Awareness constitutes the catalyst, which in turn entails a prerequisite in the form of education and training. Awareness, safe working procedures, contractor planning, workshops on site, mechanization, constructability (general), design of equipment (construction), reengineering, prefabrication, design of tools, materials handling, working platforms, means of ascending/ descending, materials storage, walkways and clear circulation paths on site would improve site ergonomics (Smallwood, 2012)

Procuring new hand and power tools that are ergonomically designed for a better comfort grip so to reduce employee squeeze tension, vibration or awkward posturing of the arm, hand and/or body (DeVita, 2012). These tools are a little more expensive; however, if proven to help reduce employee discomfort and injuries, they would be a good investment.

1. According to Smallwood and Ajayi (2007) ergonomics can be enhanced through;

2. Training on WMSDs': as training enlightens construction workers relative to the activities they undertake, *inter alia*, appropriate methods of lifting loads, and thus training can mitigate the onset of WMSDs;
3. Site layout planning: as it promotes safe and efficient operations on construction sites, through inter alia, mechanisation.
4. Work organisation: as it enables optimum work activity.
5. Work method: as the work method determines the impact of an activity on the human body.
6. Housekeeping: as optimum housekeeping establishes and maintains an orderly work place in terms of storage and the lack of obstructions, thus affording optimum access and the mitigation of hazards.
7. Job fitness: as being fit can mitigate the experiencing of strains and sprains.

According to Dubblestyne (2008) practices to improve ergonomics implementation include involving employees at all levels, implementing sustainable communication mechanisms (weekly safety talks, ergonomics newsletters or bulletin boards), including ergonomics in the mandate of the joint health and safety committee, or implement a separate committee, making ergonomic sciences a mandatory component of curriculums and increasing training (awareness and specific) in a workshop format.

Changes in tools and equipment; stretch and flex programs; and training and education, job rotation, job organization and pre-planning, personal protective equipment, and job hazard analysis can improve ergonomic in construction.

According to Boatman, Chaplan andTeran (2012) this actions by contractors can help reduce ergonomic injuries in construction

1. Purchasing/using redesigned tools, equipment or material

2. Develop a written ergonomics policy (could cover: job/task analysis, materials handling/lifting guidelines, and mechanism for worker input).
3. Provide worker training on ergonomics.
4. Re-organize work to provide: reasonable workload, sufficient breaks, controlled pace,
5. Task variety, job rotation, etc.

CHAPTER THREE

RESEARCH METHODOLOGY

The term ‘Research’ can be explained as the systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions. A research problem refers to a difficulty which a researcher or a scientific community or an industry or a government organization or a society experiences. It calls for a thorough understanding and possible solution. Research methodology is a systematic way to solve a problem. This chapter explains the methodology chosen for the research and the instrument used in satisfying the objectives.

3.1 Research Method

The research adopted both the quantitative and qualitative research methods. Quantitative research involves collection and analysis of numerical data and the type of data collected are in numbers and statistics. Quantitative research makes use of tools such as questionnaires, surveys, measurements and other equipment to collect numerical or measurable data. While in qualitative research the type of data collected are in words, images or object. Data-gathering strategies used in qualitative research are field notes, open ended responses, structured and non-structured interviews, focus groups, narratives, content or documentary analysis, observation and archival research. This research would use a checklist to obtain quantitative data. An interview would be conducted with selected craftsmen. The research method (Interview and site observation) was adopted from and also used by Alswaity and Enhassi (2012) where they studied construction ergonomics relation to safety.

3.2 Data Collection Technique

Three sources of information were used for the study. The first is the existing literature on the subject matter, which would be in chapter two. The second source of information was the interview. Data was also obtained using a checklist filled by site observation.

3.3 Administration of the Instrument

The interview was personally conducted by the researcher. The checklist was filled by the researcher using site observation of the selected building construction craftsmen on site.

3.4 Population Size

The population of the research consist of craftsmen and artisans on construction sites. The population of this study is infinite. The number of craftsmen (Carpenters, Iron-Fixers, Tillers, Masons and Electricians) in the study area cannot be determined. Therefore the research adopted an infinite population size.

3.5 Sample Size

It is usually impossible for a researcher to study the whole population of his research. The researcher finds a way to select an appropriate number which can represent the population of his study. According to Fellow and Lui, (2007) a sample is required to be consistent, sufficient, efficient, and unbiased.

The sampling size was determined based on the formula Cochran's formula for calculating sample size when the population is infinite (Cochran, 1977):

$n = (z^2pq)/ d^2$ ---------- 1

Where;

n = the desired sample size

z = the ordinate on the Normal curve corresponding to α or the standard normal deviate. For the purpose of this study, a confidence level of 90% will be adopted.

Usually a 90% level of confidence has $\alpha = 0.10$ and critical value of $z_{\alpha/2} = 1.64$.

P = the proportion in the target population estimated to have particular characteristic (normal between the range of 0.1 - 0.5)

q = 1.0-p

d = degree of accuracy corresponding to the confidence level and Z selected.

Consequently, the sample size is determined as thus,

z = 1.64
d = 0.1
Where **p** = 0.2
q =0.8
Hence,
Sample size $n = [(1.64)^2 \times 0.8 \times 0.2]/ (0.1)^2 = 43$
The sample size for each type of craft (Carpenters, Iron-Fixers, Tillers, Masons and Electricians) will be 43 each

The total number is 43x5= 215

Therefore the sample size for the research is two hundred and fifteen.

3.6 Sampling Method

The objective of sampling as stated by Fellows and Liu (2007) is to provide a practical means of enabling the data collection and processing components of research to be carried out whilst ensuring that the sample provides a good representation of the population. Stratified sampling was used for the research. A stratified sampling is said

to be more representative of a population than a survey of simple random or systematic sampling

3.7 Research Design

This research was carried out in five phases with each of the stages representing each of the chapters one to five. The stages are highlighted and explained below as shown in figure 3.1.

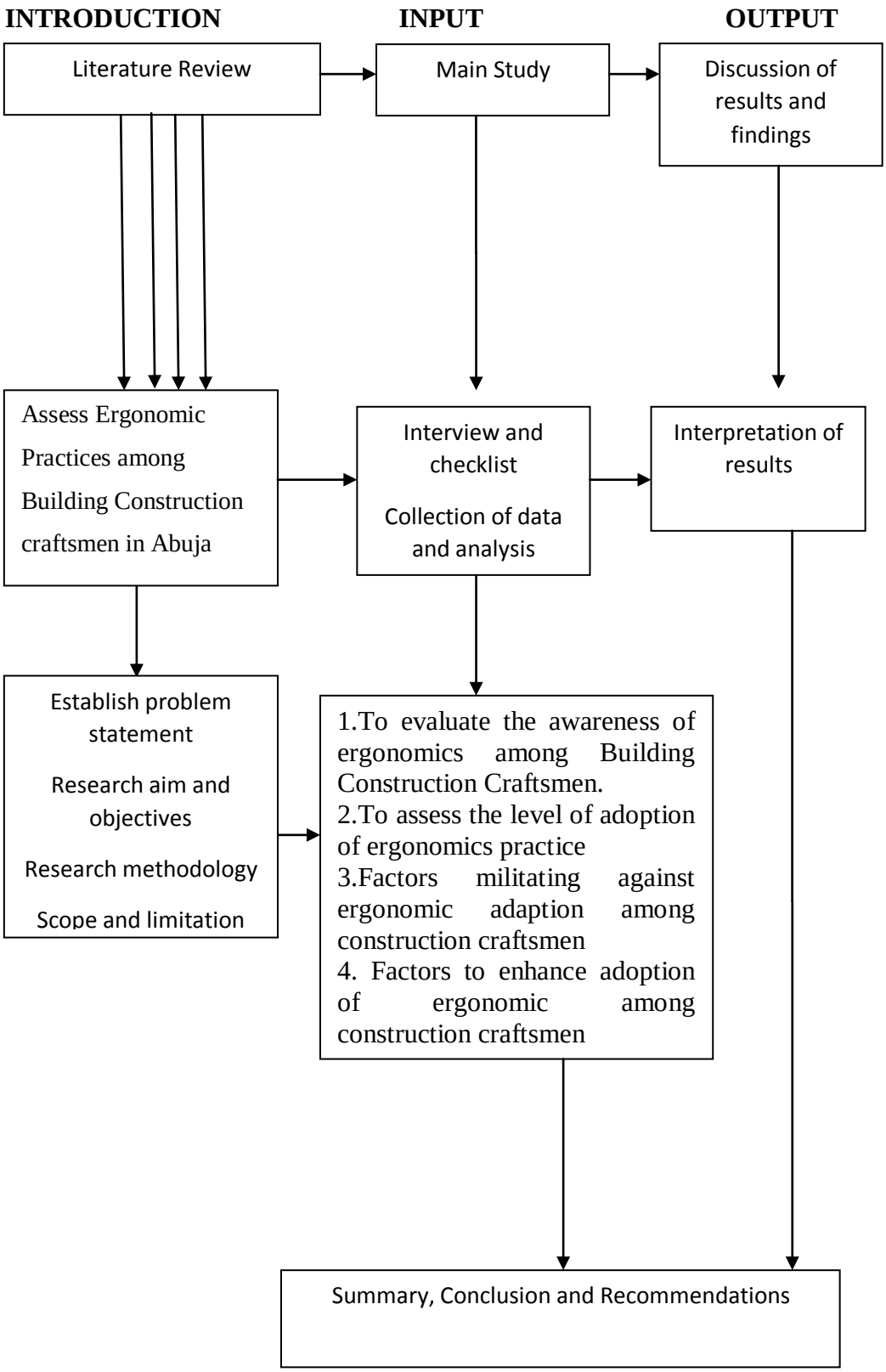


Figure 3.1: Research Design (AbdulAzeez, 2012)

Phases 1: Phase one (1) is the introduction of the thesis, it entails preliminary reading, selection of topic, identification of research problem(s), determination of aim and objective of research and determining the scope of research.

Phases 2: The second phase of this research (stage 2) includes an extensive review of literature on ergonomics and ergonomic practices in the building construction industry. It also entails reviewing both global and local materials and sources

Phases 3: Phase 3 would determine the methodology used in the research. It included the use of the research instruments (checklist and interview) to obtain primary data.

Phases 4: Analysis of results obtained from the interview conducted and checklist. Data analysed was discussed from which inferences were made.

Phases 5: Phase 5 entails summary, conclusion and recommendation. Summary of the major findings of the research, conclusions were drawn from the various findings and recommendations were made on how the problems identified by the research can be addressed.

3.8 Research Instrument

Primary data was obtained by interview and a checklist. The interview was conducted with craftsmen. The checklist was taken to building construction sites.

3.8.1 Interview

The interview was conducted with craftsmen on construction site. The interview contained four parts. The first part was on the personal profile of the respondent. The second part tested the level of awareness of the respondent on ergonomics and ergonomic injuries. The third part of the interview looked into factors militating against the implementation of ergonomics. The fourth section inquired on factors that could encourage the practice of ergonomics on construction sites amidst craftsmen.

3.8.2 Checklist

The checklist was used to assess level of practice of ergonomics on building construction sites. The checklist was developed from 'Ergonomics for Construction Workers' by the United States National Institute of Occupational safety and Health.

3.9 Methods of Analysis

In the analysis of data obtained in the study, descriptive data analyses was used using percentages. The percentage method is a simple technique of data analysis that does not involve any complex mathematical calculation.

$$= \frac{\text{Number of Respondents}}{\text{Total Number of Respondents}} \text{ x } 100 \text{ ---------- } \mathbf{2}$$

CHAPTER FOUR

DATA PRESENTATION ANALYSIS AND DISCUSSION

4.1 Craftsmen Profile

Table 4.1 shows the number of respondents to the research. The sample size was One hundred and eighty. Thirty five for each category of the five craftsmen. Only One hundred and twenty five craftsmen response was found worthy to be included in the survey. This represents a Sixty nine percent (69%) response rate. This percentage can be considered appropriate and an adequate representation of the population of this study and therefore valid for consideration and use for the study based on the assertion of Albinu and Jagboro (2002) that the result of a survey is acceptable if the response rate is above 40% .

Table 4.1; Number of respondents

Number of Distributed	215
Number properly completed and returned	125
Percentage response.	58%

Source: Field Survey, 2015

4.1.1 Type of craft

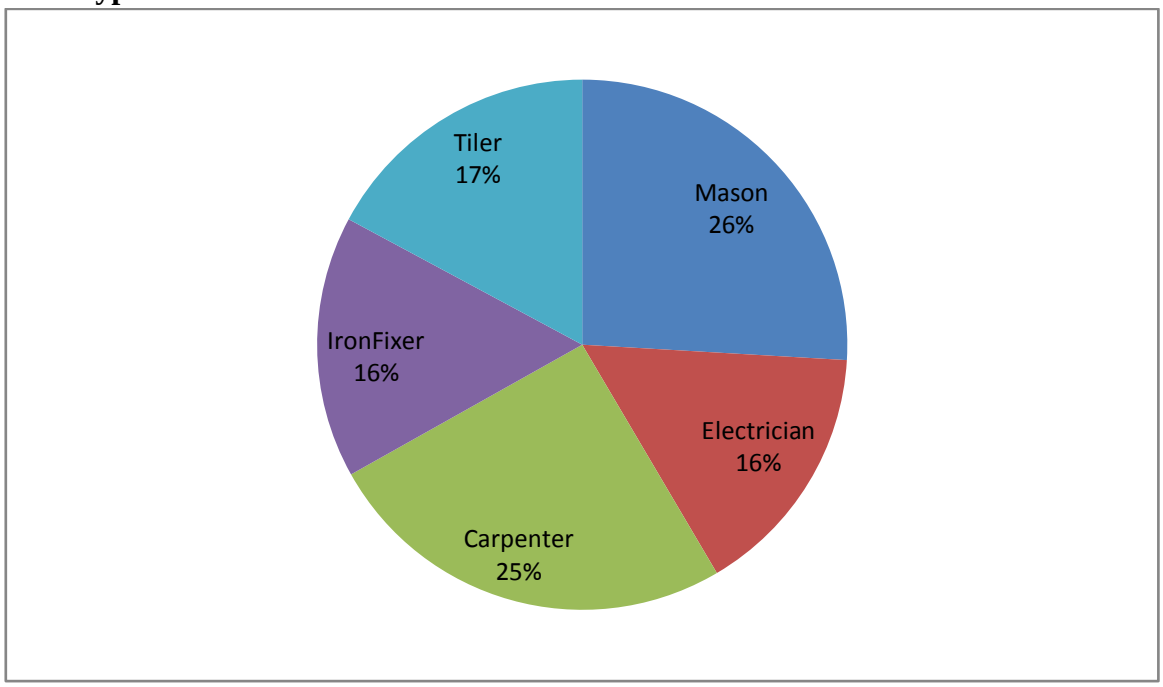


Figure 4.1; Craft of respondent
Source: Field Survey, 2015.

Table 4.2 shows the distribution of craftsmen who responded to the survey. It can be seen that 25.6% were Masons, 16% were Electricians, 26% of the responded were Carpenters by trade. Other respondents were Tilers and Iron Fixers representing 16.4% and 17.6% respectively. There response rate were higher among masons, electricians and tillers because most project site visited were at the construction stage were these types of artisans are mostly found.

4.1.2 Working experience of craftsmen

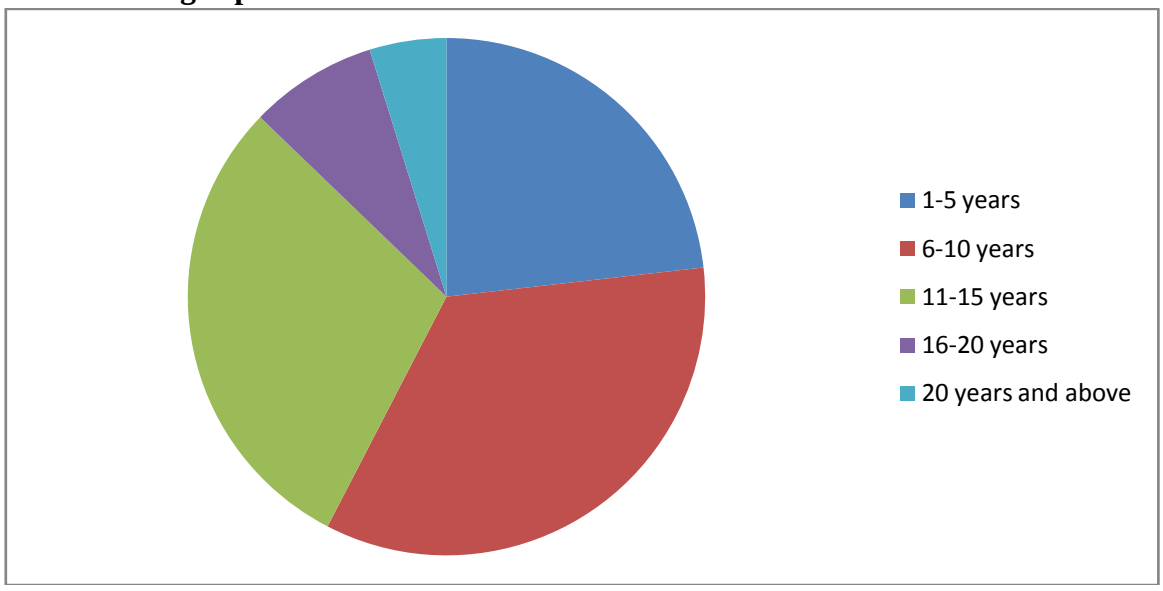


Figure 4.2 Working experience of craftsmen
Source: Field Survey, 2015.

Figure 4.2 shows the working experience of respondents. It can be seen that 34.4% of respondent have working experience of 6-10 years, 29.6% have working experience of between 11-15 years and the least percentage 4.8% have working experience of 20 and above. Also 29% of the respondents have working experience of 1-5 years. 8% have working experience of between 16-20 years. It could be said that respondents have adequate knowledge and experience in their trades. It could also be seen that there is a blend of both new and old craftsmen.

4.1.3 Type of craft

Table 4.2 Type of Training

Type of response	Frequency	Percentage (%)
College based training	43	34
Non College based training	82	66
Total	125	100

Source: Field Survey, 2015.

Table 4.2 shows the type of training craftsmen went through to acquire their skill. While 65% passed through Non-college-based training: Apprenticeship, 34% of respondents

have college-based training: Primary, Secondary, Technical College, Trade Schools, Polytechnics etc. It is imperative to note that most of the craftsmen in the building construction industry do not have formal education. Most of the craftsmen were trained informally.

After asking questions on the respondent's profile, the interview continued with questions on ergonomics awareness and ergonomics injuries.

4.2 Awareness of Ergonomics among Building Construction Craftsmen

Objective One which is on assessing awareness of ergonomics among craftsmen was achieved in this section

4.2.1 Awareness of ergonomics

Table 4.3: Awareness of ergonomics

Type of response	Frequency	Percentage (%)
Aware	24	81
Not Aware	101	19
Total	125	100

Source: Field Survey, 2015

The study inquired on awareness of ergonomics. Craftsmen were asked if they know ergonomics. Table 4.3 shows that 81% of respondents are not aware. Other response from this questions included words like 'never' and 'this is the first time am hearing the word'. 21% of respondents said they are aware.

In ensuring that respondents who claimed to know ergonomics understand understands it. The researcher went further to ask what it means. Out of the twenty four only five gave answers related to ergonomics which included ergonomics as a study of people working, study of people at work, making the worker comfortable while working. This shows that shows that only a few 4% of the respondents really know what ergonomics is.

The awareness of ergonomics among craftsmen in the building construction industry is low. This cut across both new and old craftsman as shown in Table 4.3. This might be due to the fact that most craftsmen were trained informally as shown in Table 4.4 and they may not been able to come across information on ergonomics. Due to the fact that most employers rarely train craftsmen most craftsmen might not have had the opportunity to come across information on ergonomics.

After the question on ergonomics the researcher chose to educate the workers on the definition of ergonomics and ergonomic injuries. This was done to help the respondents have a better understanding of the subject matter so they would be able to address other questions appropriately.

4.2.2 Work Related Musculoskeletal Disorder

Table 4.4: Craftsmen experience on Work Related Musculoskeletal Disorder

Type of response	Frequency	Percentage (%)
Yes	83	66
No	42	34
Total	125	100

Source: Field Survey, 2015.

During the course of the education signs and symptoms of work related musculoskeletal injuries and disorders were listed and explained to the craftsmen. This was followed by a question on if they have experienced the signs and symptoms before. From Table 4.4 it can be seen that 66% of respondents have experienced Work Related Musculoskeletal Disorder before while 34% have not experienced it yet. From the result above majority of workers have Work Related Musculoskeletal Disorder. This further reaffirm that musculoskeletal injuries exist among construction craftsmen and it is a problem being faced by construction workers. This is also in line with Smallwood and Ajayi (2007) and Thwala (2015) where they assert that every construction worker is

likely to be temporarily unfit to work at some time as a result of moderately serious injuries or health problem after working on a construction site.

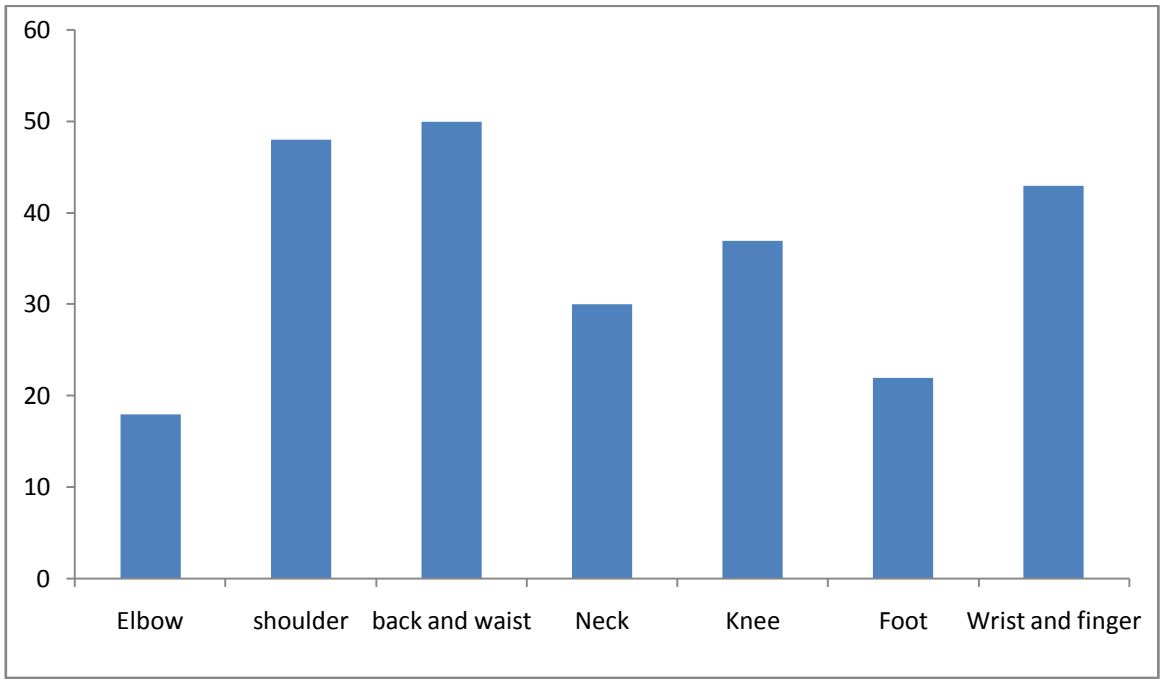


Figure 4.3: The body part(s) where discomfort occurred most
Source: Field Survey, 2015.

The researcher asked craftsmen who have experienced ergonomic injuries which part of the body they feel discomfort most. The result is presented in Figure 4.3 18 craftsmen have experienced pain in the elbow. Shoulder injury is experienced by 48 craftsmen. 50 experienced back and waist problem. Pains in the neck have occurred among 30 craftsmen. Discomfort in the knee accounted for 37 injuries while 43 craftsmen experience pain in the wrist.

During the interview electricians complained more of discomfort at the shoulder, neck, leg, waist and arm. Masons complain of waist, rib, back and shoulder. According to carpenters they felt pain in the wrist, shoulder, arm, knee and muscle. Back, wrist, arm and back problems were repeatedly mentioned by tillers. While Iron-fixers complain of body pain, shoulder arms, back, waist and foot. The shoulder and neck problem can be linked to working overhead

The physical nature of the construction industry has effect on the body. The back problem could be linked to the prolonged and repeated bending while working, lifting and picking up material at ground level.

Table 4.5: Reporting symptoms of musculoskeletal injuries

Type of response	Frequency	Percentage (%)
Yes	113	90.4
No	12	9.6
Total	125	100

Source: Field Survey, 2015.

Table 4.5 shows response of craftsmen when they were asked if they report cases of musculoskeletal injuries to their superior or supervisors. 90.4% commented that they don't report cases to anyone while 9.6% have reported cases of musculoskeletal injuries to their supervisors or superior.

It shows that construction workers don't report musculoskeletal injuries most times. This could be due to the fact that they feel the pain is part of the job and they are not aware of the danger of these injuries.

4.2.4 Craftsmen Response to musculoskeletal injuries

The research looked into what respondents do when they feel symptoms of musculoskeletal injuries. This was done to know how workers manage injuries. Most of the craftsmen practice self medication by taking pain reliever like Tramol and Paracetamol. Others relax, take rest and break from work. Some respondents seek medical care by visiting the pharmacy and the doctors.

Many construction workers practice self medication this could be because they feel pain is the part of the job. They take pain relievers to help alleviate the pain. Self medication and lack of proper treatment of ergonomic injury symptoms have been the cause of high prevalence of musculoskeletal disorder in the building construction industries. As this

pain and injuries accumulate into levels where workers can no longer perform their daily routine adequately and in some cases lead to permanent disorder and eventually to the dearth of skilled craftsmen in the industry.

4.2.5 Ergonomics risk factors

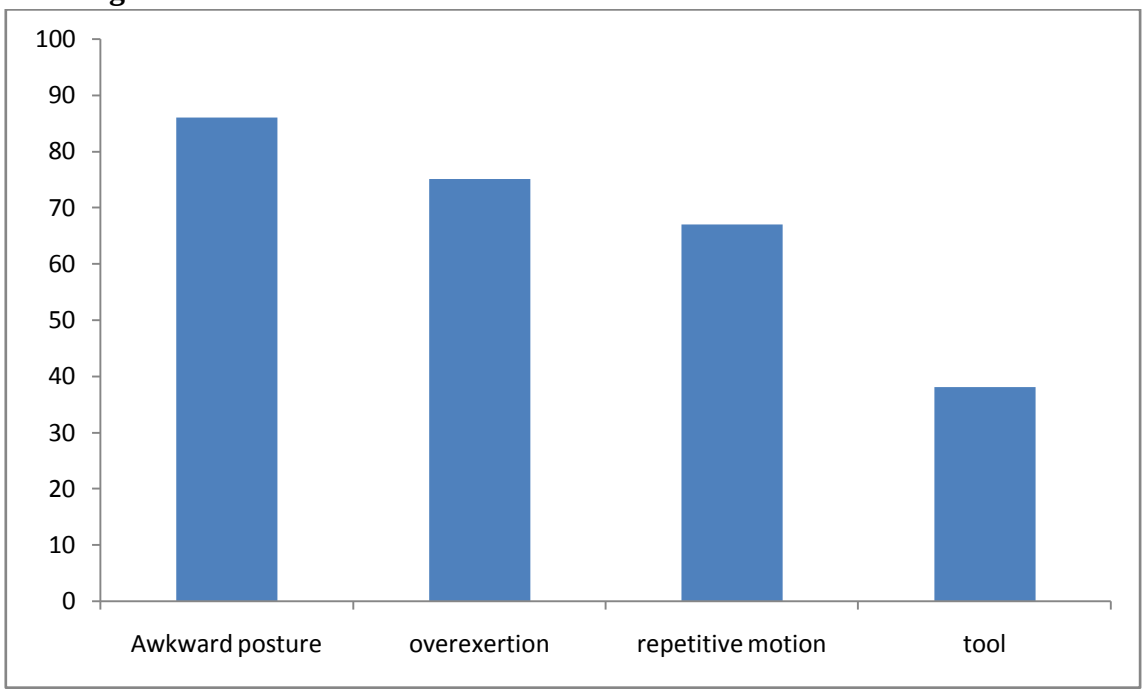


Figure 4.4: Ergonomic risk factor
Source: Field Survey, 2015.

The study probed into the aspect of their job that contributes to prevalence of Work related Musculoskeletal Disorders. It is believed that construction jobs have high incidence of Work related Musculoskeletal Disorders. As shown in figure 4.4 the most prevalent source of injury was awkward posture (69%), overexertion (60%), repetitive motion (54%) and tools (30%).

Over exertion has to do with working for long period of time without rest. This occurs while trying to finish the work quickly or while tirelessly to meet work target. This has effect on the worker because it causes exhaustion. The lesser amount of rest makes them venerable to various injuries over a period of time.

Working in the construction is physical in nature and most construction materials are heavy. This involves lifting, pushing pulling and carrying. Movement of these materials from location where they are stored to place of use is stressful. Mason usually complained of lifting heavy sandcreet block. While the steel worker complain of lifting and transporting steel on site. While tillers complained about working with cartons of tiles. Even though size varies sometimes the carpenter has to lift large and heavy section of wood to be nailed in place.

Craftsmen perceive repetitive motion as an injury risk factor. Example of these is a mason bending and picking up hundreds of sandcreet blocks rising and placing them. This movement is continues throughout the day every day. This has been linked to back pain. While a carpenter performs the repeated motion of hammering nail. This causes pain in the wrist. The iron fixer while fixing or tying stirrups in placing reinforcement repeat the movement of twisting the wrist continuously. The examples stated above are risk factors for WMSD's.

Respondents stated that awkward postures they take while working may be the cause of musculoskeletal injuries. Awkward postures means working with various part of the body in bent extended or flexed rather than in a neutral position. Examples of awkward position stated by craftsmen include.; electricians and plumbers bending the neck backward or forward for prolonged period while working overhead, bending the knee or ankle to work in squatting or kneeling position. Iron benders bending for a long period tying reinforcement. Other risk factors mentioned by respondents include working with tools.

4.3 Ergonomic Adaptation

Ergonomics practices in this study looked into four areas which are working methods and ergonomic equipment or tools and the use of ergonomic personal protective

equipment. Craftsmen were observed while working. In order to have a true picture of the working methods and procedures craftsmen were told they were being observed but they were not informed on what basis they were being observed.

4.3.1 Site observation of Carpenters

Table 4.6: Site observation for Carpentry operation

	Carpenters	Yes	Percentage	No	Percentage
1	Use of all other personal Protective Equipment	13	39.4	20	60.6
2	Knee pads	2	6.1	31	93.9
3	Leg wedge	0	0	33	100
4	Shock absorbing shoe inserts	2	6.1	31	93.9
5	Gloves	6	18.2	27	71.8
6	Materials stored near place of use	31	93.9	2	6.1
7	Nail and screw gun	0	0	33	100
8	Adjustable saw horse	0	0	33	100

Source: Field Survey, 2015.

4.3.1.1 Ergonomics tools

The use of ergonomics tools was observed while the carpenter works and shown in Table 4.6. It was observed that there was no use of adjustable saw horse in any of the site. Only a fixed saw house was seen. It was also observed that then Nail and screw was not seen on any site.

4.3.1.2 Ergonomics personal protective equipment

The use of personal protective equipment was observed while carrying out carpentry operations on site. The percentage of carpenters using hand gloves while working is 18.2% while 81.8% do not. It was observed that only 6.1% had safety boots with safety boots with shock absorbing inserts while 93.9% do not have shoes or the with shoe inserts. Only 6.1% of respondents were found to use knee pads while working, 93.9% do not make use of kneepads.

Very few carpenters stretch and exercise during the days job. It is important to stretch which will enhance blood circulation around the body and also return the body to neutral position after working in an awkward position. This could be linked to lack of knowledge on ergonomics.

It can be seen that use of ergonomics PPE was low among carpenters the use of kneepads, leg wedge, hand gloves were found to be little to non existence. This shows that the use of ergonomics PPE is not being used.

Ergonomic tools are not being used by carpenters. Adjustable saw horse, nail gun and shock absorbing shoe inserts are not being used by carpenters on construction sites.

4.3.2 Site observation of Iron-Fixers

Table 4.7: Site observation for metal work operation

	Iron-Fixer	Yes	Percentage	No	Percentage
1	Rebars stored near place of use	22	68.8	5	31.2
2	Rebars stored above ground level	8	28.6	20	71.4
3	House keeping	12	31.8	16	68.2
4	Weight restriction of 50kg	3	10.7	24	89.7
5	Shock absorbing shoe inserts	13	46.4	15	53.6
6	Hand gloves	18	64.2	10	35.7
7	Shoulder pads	8	28.6	20	71.4
8	Rebar tying tool	0	0	28	100

Source: Field Survey, 2015.

4.3.2.1 Working method and procedure

Working practices of iron fixers were observed. Rebars stored near place of use to enhace work flow and make the task easier. From observation 68.8% of material were stored near it the place of use. Only 28.6% of rebars were stored above ground level to prevent too much bending. 31.8% conduct good housekeeping while 69.2 do not conduct proper housekeeping. There was no restriction on the amount of load to be

carried by a craftsman which shouldn't be more than 50kg. In most site 90% do not have while 10% have.

4.3.2.2 Ergonomics personal protective equipment

The use of personal protective equipment was observed while carrying out carpentry operations on site. 64.2% of iron fixer use hand gloves while 35.7 do not use . 28.6% use shoulder pads while 71.4% do not use shoulder pads while working.

4.3.2.3 Ergonomic equipments

It was also observed that there was no use of Rebar tying tool by iron fixers.

Stretching and exercise among iron fixer was also low. Very few iron fixers were seen to observe stretching before, during and after working. On practice of storage of re-bars near the place of use it was observed that on most sites they are. On storage/ stacking of re-bars above ground level most site store rebars on the ground rather than stacking it on a platform. It was also observed that there were no proper house-keeping by iron fixers. According to the International Labour Organisation there should be a weight lifting restriction of 50kg by a manually single worker. It was observed that workers lift weight above 50kg without restriction.

Some iron fixers were found to use hand gloves and shock absorbing inserts in their boots which is encouraging compared to very few who use shoulder pads. No rebar tying tool was found to be used. It could be said that adoption of ergonomics among iron fixers can be said to be low

4.3.3Tilers

Table 4.8: Site observation of tilling operation

	Tillers	Yes	Percentage	No	Percentage
1	Shock absorbing shoe inserts	2	11.1	16	88.9
2	Knee pads	0	0	18	100
3	Kneeling creepers	0	0	18	100
4	Hand gloves	8	44.4	10	54.6
5	Providing tripod benches to reduce cutting at ground level	7	38.9	11	61.1

Source: Field Survey, 2015.

4.3.3.1 Ergonomics personal protective equipment

It was observed that there was no use of equipments like knee pads and knelling creepers. Only 11.1% have absorbing shoe inserts. Site observation has shown that 44.4% use hand gloves while working.

4.3.3.2 Ergonomic tool

Only 39% of tillers make use of tripod benches to reduce cutting at ground level.

On the use of ergonomic personal protective equipment 11% use shock absorbing shoe inserts, none of tillers use knee pads and kneeling creepers while 44% were found to use hand gloves. The use of personal protective equipments by tillers can be seen to be low. The use of ergonomic tool by tillers was at the rate of 39%.

4.3.4 Site observation of Masonry work

Table 4.9: Site observation for masonry work

	Masons	Yes	Percentage	No	Percentage
1	Shock absorbing shoe inserts	8	32	25	68
2	Hand gloves	12	38	20	62
3	Adjustable/split level scaffold	0	0	32	100
4	Motorised screeding machine	0	0	32	100
5	Light weight block	0	0	32	100
6	Blocks notches for hand grip	0	0	32	100
7	Tool handle not exceeding base of the palm	20	62	12	38
8	Tool handle Rounded, soft	18	55	15	45
9	Tool handle Slip resistant	16	48.5	17	51.5

Source: Field Survey, 2015.

4.3.4.1 Ergonomics personal protective items and equipment

From table it 4.8 it can be seen that 32% have shock absorbing inserts in their safety boots, 68% do not use shock absorbing inserts. 62% of masons do not make use of hand gloves while working, 38% do. It was also observed that there was no use of adjustable/split level scaffold, motorised screeding machine, light weight block and blocks with blocks notches for hand grip.

4.3.4.2 Tools ergonomics

It was observed that 62% of hand trowel handle observed do not exceed the base of the palm, while 38% do. 55% of trowel handle are rounded and soft while 45% were found not to be. Only 48.8% handle of trowel used by masons were found to be slip resistant while 51.2% were found to be slippery.

It was observed that masons stretching after a lengthy duration of an extended work posture and after the day's job. While it was observed that stretching and exercise was found to be low prior to the days job and during break. Stretching and exercise can be

said to be higher among mason than other craftsmen observed. This could be because of the nature of their work which has to do with repeated lifting and bending.

The use of personal protective equipments (shock absorbing shoe inserts and hand gloves) was found to be low. There was no use of split level scaffold, motorised screeding machine, light weight blocks and notches in blocks for hand grip. Tools were found to be ergonomically designed

4.3.5 Site observation of Electrical work

Table 4.10: Site observation result for electrical work operation

	Electricians	Yes	Percentage	No	Percentage
1	Shock absorbing shoe inserts	3	15	17	85
2	Leg wedge	0	0	20	100
3	Knee pad	0	0	20	100
4	Handle not exceeding base of the palm	13	65	7	35
5	Handle is slip resistant	15	75	5	25
6	Moulded hand grip	8	40	12	60

Source: Field Survey, 2015.

4.3.5.1 Ergonomics personal protective items and equipment

15% of electricians use shock absorbing shoe inserts while 85% don't use it. No electrician was found using both kneepad and leg wedge.

4.3.5.2 Tool ergonomics

It was observed that 65% of electrician and screwdriver handle observed do not exceed the base of the palm, while 35% did. 75% of trowel handle are rounded and soft while 25% were found not to be. It was observed that only 40% handle of trowel used by masons were found to be slip resistant while 60% were found to be slippery.

The practice of stretching among electricians can be seen to be low as seen in Table 4.10 the highest figure on compliance was at 30%. On the use of ergonomic personal

protective equipment no leg wedge and knee pad were found to be used by electricians. While shock absorbing inserts was found to be low among electricians.

Most tools used by electricians were found to meet ergonomics standard as they were found to be slip resistant, Tool handle were not exceeding base of the palm and were found not to be moulded.

4.4. Factors Militating Against Ergonomic Adaption among Construction Craftsmen

Table 4.11: Factors militating against ergonomic adaption among construction craftsmen

S/n	Factors militating against adoption	Frequency (Nr)	Percentage (%)
1	Lack of knowledge and understanding of ergonomics	99	79
2	Cost of procuring ergonomic equipment	86	69
3	Change can result in loss of jobs,	43	36
4	Employees reluctant to use safety tools and gadgets	75	60
5	Business and financial concerns	50	40
6	lack of legislation enforcing ergonomics practices	72	58
7	Temporary employment	63	50

Source: Field Survey, 2015.

The research probed into factors militating against adoption of ergonomics practices by craftsmen. Table 4.11 shows the perception of craftsmen. Lack of knowledge and understanding of ergonomics (79%), Cost of procuring ergonomic equipment (69%). Employees reluctant to use safety tools and gadgets (60%) lack of legislation enforcing ergonomics practices (58%) and Temporary employment (50%) were factors perceived to be militating against adoption of ergonomics.

From the interview it was observed that ergonomics awareness is very low among construction craftsmen. Many respondents aren’t aware of ergonomics . Many of the

ergonomics intervention aren't known to the craftsmen who are really affected by musculoskeletal injuries. Cost of procuring ergonomic equipments are high. Most craftsmen cannot afford to purchase these equipments. When an iron-bender was told it could take over a hundred thousand naira to purchase a Rebar tying tool. He was astonished. Carpenters were asked if they were aware of how easy the nail gun can make their job easier they were aware but most of them were aware of how expensive the nail gun is. Other respondents couldn't afford other ergonomic personal protective equipment like the knee guard, kneeling creepers. And it is the responsibility of the contractor to purchase some of these equipments like the motorised screeding machine because of the cost.

Some employees find it difficult to use the safety tools and equipments even when it is provided. From the interview some respondent an electrician complain of being uncomfortable wearing a helmet knee guard and leg wedge together. They feel uncomfortable and feels it could affect their output. They work better when they are 'free'. Respondent perceived that some of their colleagues choose not to use this equipment even though they are aware of the importance of using them.

There is lack of legislation enforcing ergonomics practices in the Nigerian construction industry. There is no provision for health and safety plan for construction projects and health and safety practices are not enforced. Currently in Nigeria ergonomics is not even part of the proposed health and safety plan in the National Building code. This notion was echoed during the interview by craftsmen that because of the absence of law to enforce ergonomics implementation is by choice. But if it was part of the law contractors and companies could be fined or sanctioned for refusing to implement ergonomic intervention.

Another important factor militating against adoption of ergonomics practices mentioned by respondents was the nature of their employment being temporary. They are employed based on project to project basis and their payment is either weekly or daily basis so the contractor don't train them. Some of the respondents believed they were employed through recommendation from someone. It is assumed they can do a quality job so they are not given any form of training.

4.5 Factor to Enhance Adaption of Ergonomics among Construction Craftsmen

The interview also looked into ways to enhance the adoption of ergonomics by construction craftsmen. The response was grouped and shown in Table 4.7

Table 4.12: Factors to enhance adaption of ergonomic among construction craftsmen

S/n	Factors to enhance adoption	Frequency (Nr)	Percentage (%)
1	Training and education	96	77
2	Funding and Government intervention	90	72
3	Pre-assembly and mechanization to reduce the effects of various ergonomic problems	54	43
4	Involvement off labour unions	88	70
5	Contractor support and commitment to ergonomics	74	60
6	Housekeeping	55	44
7	Changes in tools and equipment	63	50

Source: Field Survey, 2015.

Training and education is ranked higher with 77% of respondent agreed it will enhance adoption. Funding and government intervention (72%) was ranked second, closely followed by involvement off labour unions (70%). Contractor support and commitment to ergonomics was ranked fifth (60%) and changes in tools and equipment (50%).

Ergonomic training and education are very important in increasing awareness. Application of ergonomics is practical; it is achieved through better task design and work procedure. Increasing awareness of applying ergonomics allows the worker to know the benefits. From the interview it was observed that most of the workers are not aware of the existence of some ergonomics equipment like knee pads while working on the knees, shock absorbing inserts in shoes and the adjustable saw horse. It is also important to note that after the interview and brief education on ergonomics some workers stated implementing some ergonomic practices like stretching. This shows the importance of training and education.

Respondents have earlier raised concern about the high cost to purchase ergonomic equipments. Most respondents believed if there is funding from organisation in the construction industry and government like grants and subsidies directed to subsidizing this equipment or into training education and research it would go a long way in enhancing adoption. That was why an iron bender speaking of a rebar tying tool said '*if it was cheaper i will buy the equipment and use since it will make work easier and faster*'.

The role of trade union varies it is believed that they usually negotiate on how to increase the wages of members. It is important to note that the trade unions have important roles to play in ensuring the health and safety of their members. In the interview respondents felt trade union should be at the forefront of ensuring employers provide a safe working environment for them. Fighting to ensure that ergonomics intervention are implemented. Trade union roles could also include providing training to members on new working procedures and method to improve health, safety and productivity.

According to the interviews craftsmen believe contractor and managers who are responsible for construction have an important role to play in enhancing adoption. This was echoed in most comment from respondents that no matter how much you want to implement something new to your work process without the manager or supervisors consent it might be difficult. Two ways the management support can help in driving adoption. Firstly through education and training and secondly providing ergonomic equipment on site. When these equipments are provided they would use them. Even though they are not permanent staff after the work they would return them to the employer for future use.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of Findings

The study assessed ergonomics practices among construction craftsmen in the building construction industry. The following are the summaries of the findings from the study:

1. The awareness rate of ergonomics among construction craftsmen is 4%
2. 66% of craftsmen have experienced musculoskeletal injuries.
3. 60% of craftsmen have experienced back and waist problem. 57% of craftsmen have experienced shoulder injury of respondents. 51% of craftsmen experience pain in the wrist. Discomfort in the knee accounted for 44.5% of injuries, while pains in the neck have occurred among 36% of respondents
4. 90.4% of craftsmen don't report musculoskeletal injury to their supervisors or superior.
5. Most of the craftsmen practice self medication by taking pain reliever. Others relax, take rest and break from work.
6. Among carpenters the use of and the use of ergonomic personal protective equipment was 8% and there was no use of ergonomic equipment.
7. The study found that 35% adapt ergonomic working procedure while the use of personal protective equipment was 46%.
8. The study found that among the use of ergonomics personal protective equipment was 13.8% and practice of ergonomic working method and procedure was 38%.
9. 35% of Masons use ergonomic personal protective equipment, 51% of hand trowel was ergonomically suitable and no ergonomic equipment was used.

10. Among electricians 5% use Personal protective equipment and 60% of tools used are ergonomically suitable.
11. Risk factors that contribute to prevalence of work related musculoskeletal disorders are over exertion and heavy work (60%), repetitive movement (54%) and awkward posture (69%).
12. Factors militating against ergonomics adoption are lack of knowledge and understanding of ergonomics (79%), cost of procuring ergonomic equipment (69%), employees reluctant to use safety tools and gadgets (60%) and lack of legislation enforcing ergonomics practices (58%).
13. Factor that could enhance adoption of ergonomics are training and education (77%) funding and government intervention (72%), involvement off labour unions (70%), contractor management support and commitment to ergonomics (60%).

5.2 Conclusion

Following are concluded from the study;

1. The awareness of ergonomics among construction craftsmen is very low.
2. Adoptability of Ergonomic practices among construction craftsmen is low.
3. Factors militating against adoption of ergonomics among construction craftsmen are lack of knowledge and understanding of ergonomics, cost of procuring ergonomic equipment, employees reluctant to use safety tools and gadgets, lack of legislation enforcing ergonomics practices and temporary employment were factors perceived to be militating against adoption of ergonomics.
4. Factors that could enhance ergonomics adoption among craftsmen are training and education, funding and government intervention, involvement of labour

unions, contractor support and commitment to ergonomics and changes in tools and equipment.

5.3 Recommendations

The following are the recommendation from the study:

1. Increasing awareness of ergonomics through education and training. Introducing ergonomics in the syllabus of construction related courses in tertiary institution, Continuous Professional Development of professional bodies and apprenticeship training of craftsmen. This will entail training the construction craftsmen to be more aware of ergonomics and work-related CTDs
2. The National assembly pass the national building code into law and ergonomics should be included in health and safety plan which would form part of the contract document.

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APPENDIX I
Interview questions

Assessment of Ergonomic Practices among Building Construction Craftsmen in Abuja

Department of Building, Ahmadu Bello University Zaria, Nigeria

1. Name of your organisation (optional)…….....
   …….....
2. Address of the organisation ..... …….....……...
   …….....…...……

SECTION A

1. Type of Craft
   Carpenters ( ) Iron- Fixers( ) Tillers( ) Masons ( ) Electrician ( )
2. Type of Training
   a.College-based training: Primary, Secondary, Technical College, Trade Schools, Polytechnics etc ( )
   b.Non-college-based training: Apprenticeship ( )
3. Years of Experience [a] 1-5 ( ) [b]6-10( ) [c]11-15( ) [d]16-20( ) [e] 21 and Above ( )
4. Do you know of ergonomics?

SECTION B

1. What is ergonomics ?
2. Have you experienced any muscle pain, tingling, numbness, loss of strength or movement before? Yes ( ) No ( )
3. Which part of the body have you frequently felt discomfort?
4. What did you do when you felt the symptoms?
5. Which risk factors do you feel is responsible for developing this discomfort (work-related musculoskeletal disorders)?

SECTION C

6. What have been the barriers to implementing ergonomic practices?

	Barriers
1	Lack of knowledge and understanding of ergonomics
2	Cost of procuring ergonomic equipment
3	Change can result in loss of jobs,
4	Employees reluctant to use safety tools and gadgets
5	Business and financial concerns
6	lack of legislation enforcing ergonomics practices
7	Temporary employment

7. Which of the following can enhance the practice of ergonomics?

	Drivers
1	Training and education
2	Funding and Government intervention
3	Pre-assembly and mechanization to reduce the effects of various ergonomic problems
4	Involvement off labour unions
5	Contractor support and commitment to ergonomics
6	Housekeeping
7	Changes in tools and equipment

APPENDIX II
Checklist

Assessment of Ergonomic Practices among Building Construction Craftsmen in Abuja
Department of Building, Ahmadu Bello University Zaria, Nigeria

1. Name of your organisation (optional)…….....
2. Address of the site .....….....……...
3. Date of Site Visit …….....…...….....

	Carpenters,	**Yes**	**No**
1	Shock absorbing shoe inserts		
2	Gloves		
3	After repeated bending and lifting for 30 minutes taking a mini break to stretch		
4	Materials stored near place of use		
5	Use of all other personal Protective Equipment		
6	Knee pads		
7	Leg wedge		
8	Nail and screw gun		
9	Adjustable saw horse		
	Iron-Fixer	**Yes**	**No**
1	Shock absorbing shoe inserts		
2	Rebars stored near place of use		
3	Rebars stored above ground level		
4	House keeping		
5	Hand gloves		
6	Shoulder pads		
7	Weight restriction of 50kg		
8	Rebar tying tool		
	Tillers	**Yes**	**No**
1	Shock absorbing shoe inserts		
2	Kneeling creepers		
3	Providing tripod benches to reduce cutting at ground level		

4	Hand gloves		
	Masons	**Yes**	**No**
1	Adjustable/split level scaffold		
2	Motorised screeding machine		
3	Light weight block		
4	Blocks notches for hand grip		
5	Tool handle not exceeding base of the palm		
6	Tool handle Rounded, soft		
7	Tool handle Slip resistant		
	Electricians	**Yes**	**No**
1	Shock absorbing shoe inserts		
2	Leg wedge		
3	**Tool ergonomics**		
4	Handle not exceeding base of the palm		
5	Handle is Slip resistant		
6	Moulded hand grip		